US005970658A

United States Patent [19]

Smith

[11] **Patent Number: 5,970,658**

[45] **Date of Patent: Oct. 26, 1999**

[54] **WINDOW REGULATOR MECHANISM**

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[21] Appl. No.: **09/073,351**

[22] Filed: **May 6, 1998**

Related U.S. Application Data

[60] Provisional application No. 60/045,698, May 6, 1997.

[51] **Int. Cl.**[6] **E05F 11/48**

[52] **U.S. Cl.** **49/352**; 49/348

[58] **Field of Search** 49/348, 349, 350, 49/351, 352, 502

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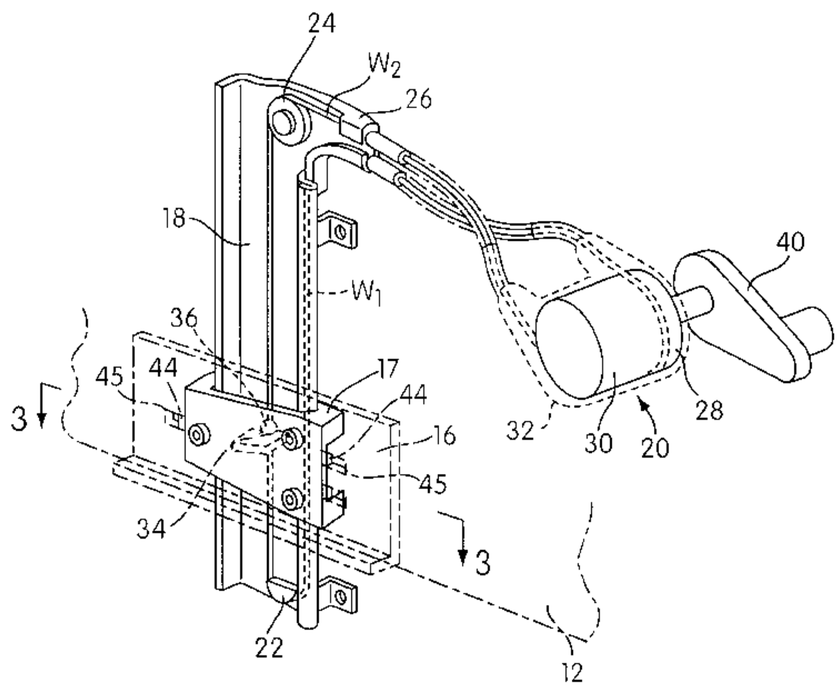
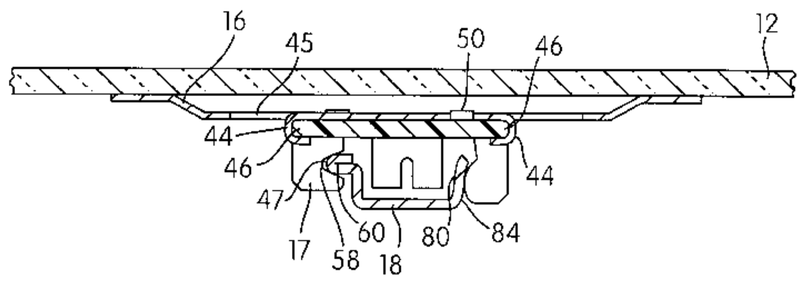
[57] **ABSTRACT**

The present invention is a window regulator mechanism for vertically moving a window panel mounted within a motor vehicle door. The mechanism comprises an elongated guide rail member mounted within the vehicle door and having a base portion with a pair of side flange portions. A first of the pair of side flange portions has a nose portion extending laterally outwardly therefrom. A second of the pair of side flange portions has a convex exterior surface. A window moving structure engages the window panel and has a base member and a pair of side leg portions extending from opposing sides thereof. One of the side leg portions has a nose-receiving groove formed in an inwardly facing surface thereof. The window moving structure is slidably mounted on the guide rail member. A manually operable actuating mechanism is constructed to slidably move the window moving structure vertically along the guide rail member. The nose portion of the guide rail member is received within the nose-receiving groove of the window moving structure and the convex exterior surface of the guide rail member is slidably engaged with an inwardly facing surface of another of the side leg portions of the window moving structure opposite the nose-receiving groove such that (1) relative pivotal movement between the guide rail member and the window moving structure about a fixed pivot axis extending longitudinally through the nose portion is permitted and (2) relative movement between the guide rail member and the window moving structure in a radial direction with respect to the fixed pivot axis is substantially restricted to thereby reduce vibrations which occur as a result of forcibly moving the vehicle door into closing engagement with a motor vehicle body.

19 Claims, 5 Drawing Sheets





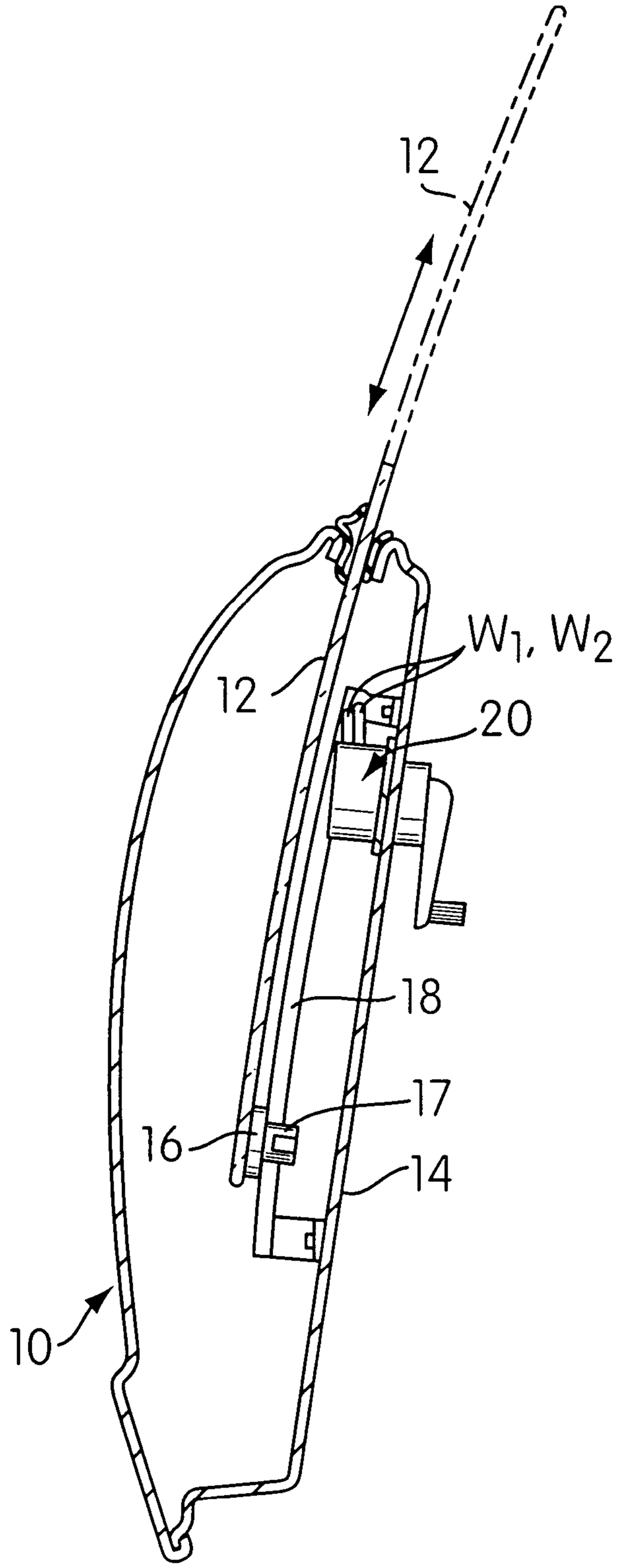


FIG. 1

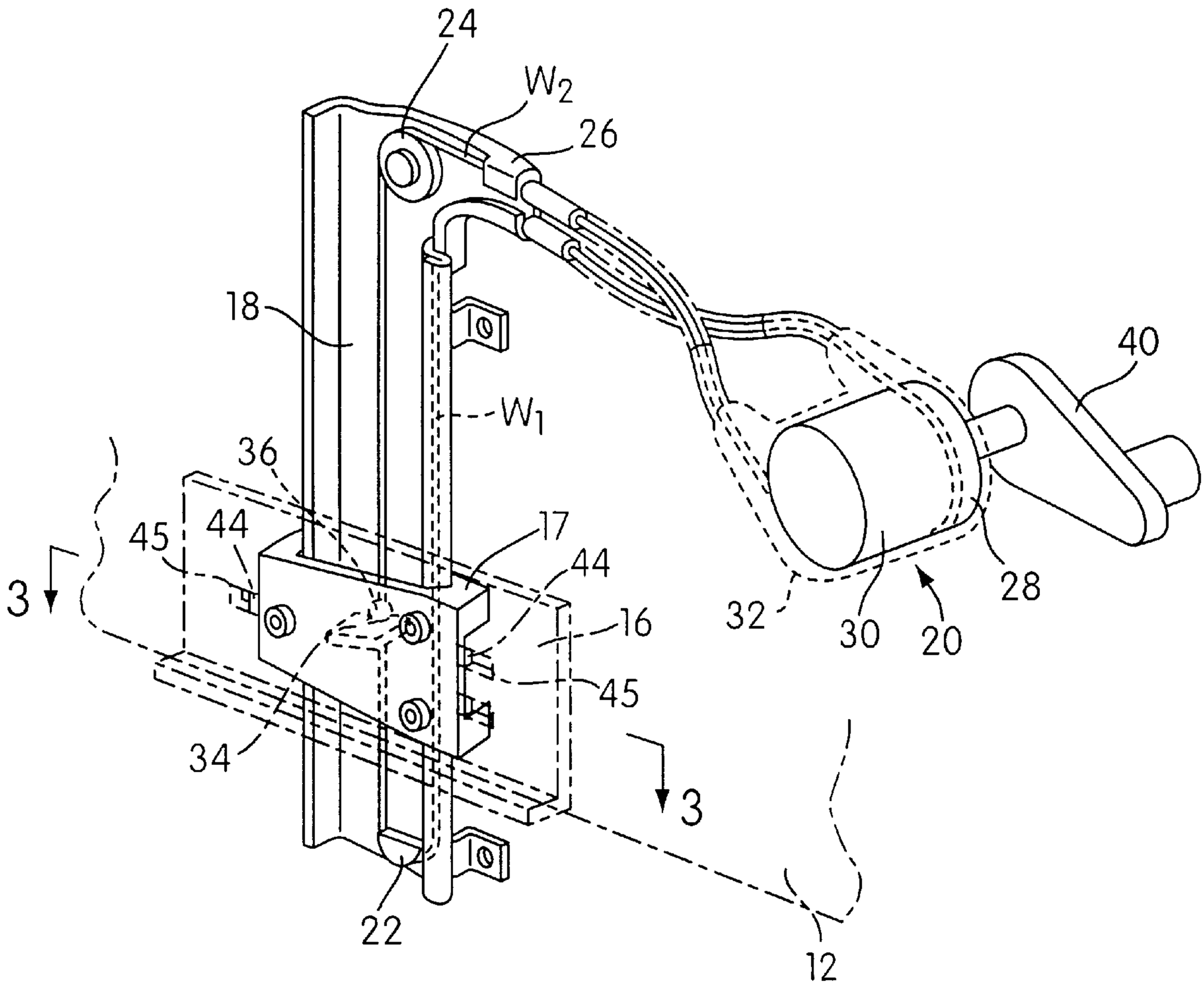


FIG. 2

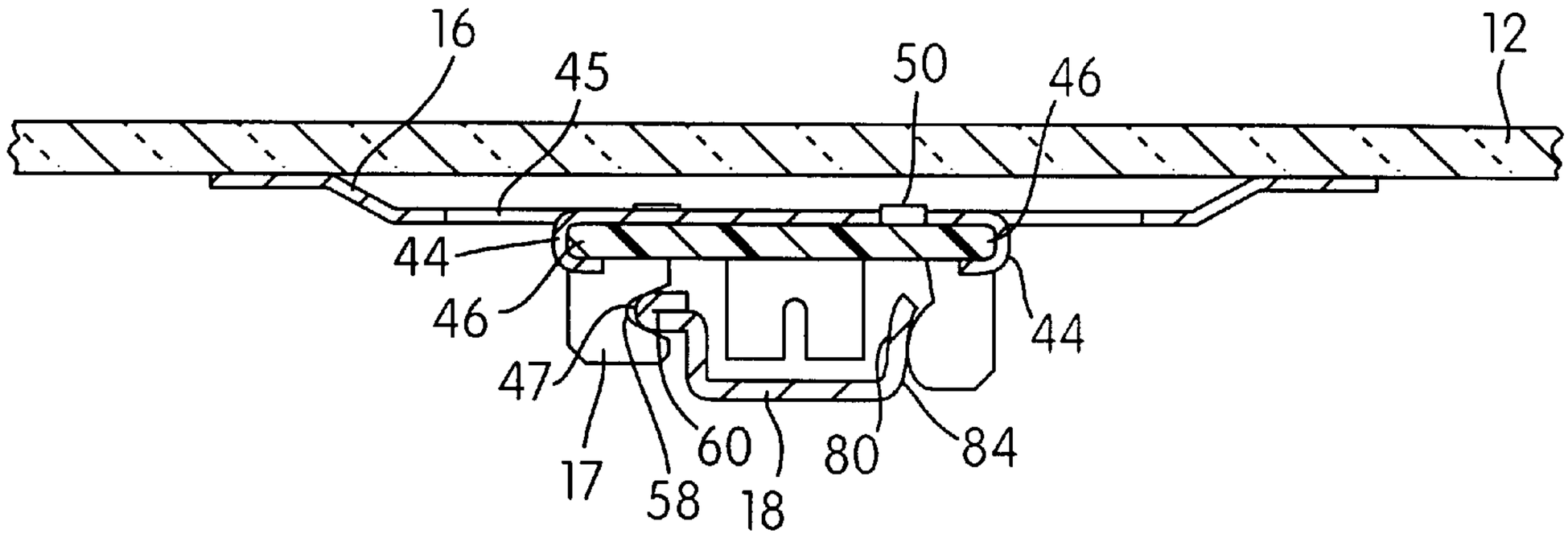

16
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FIG. 3

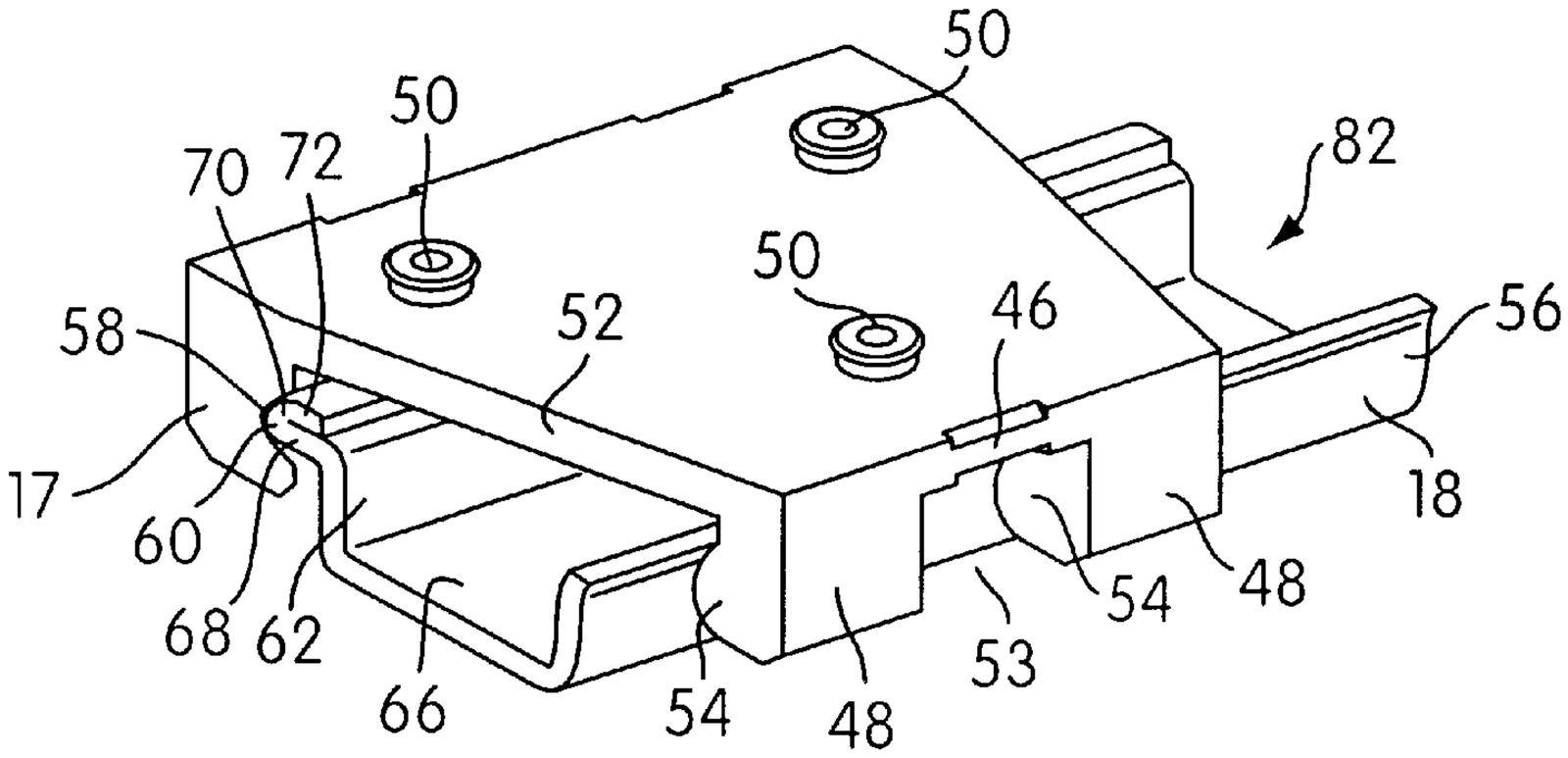
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FIG. 4

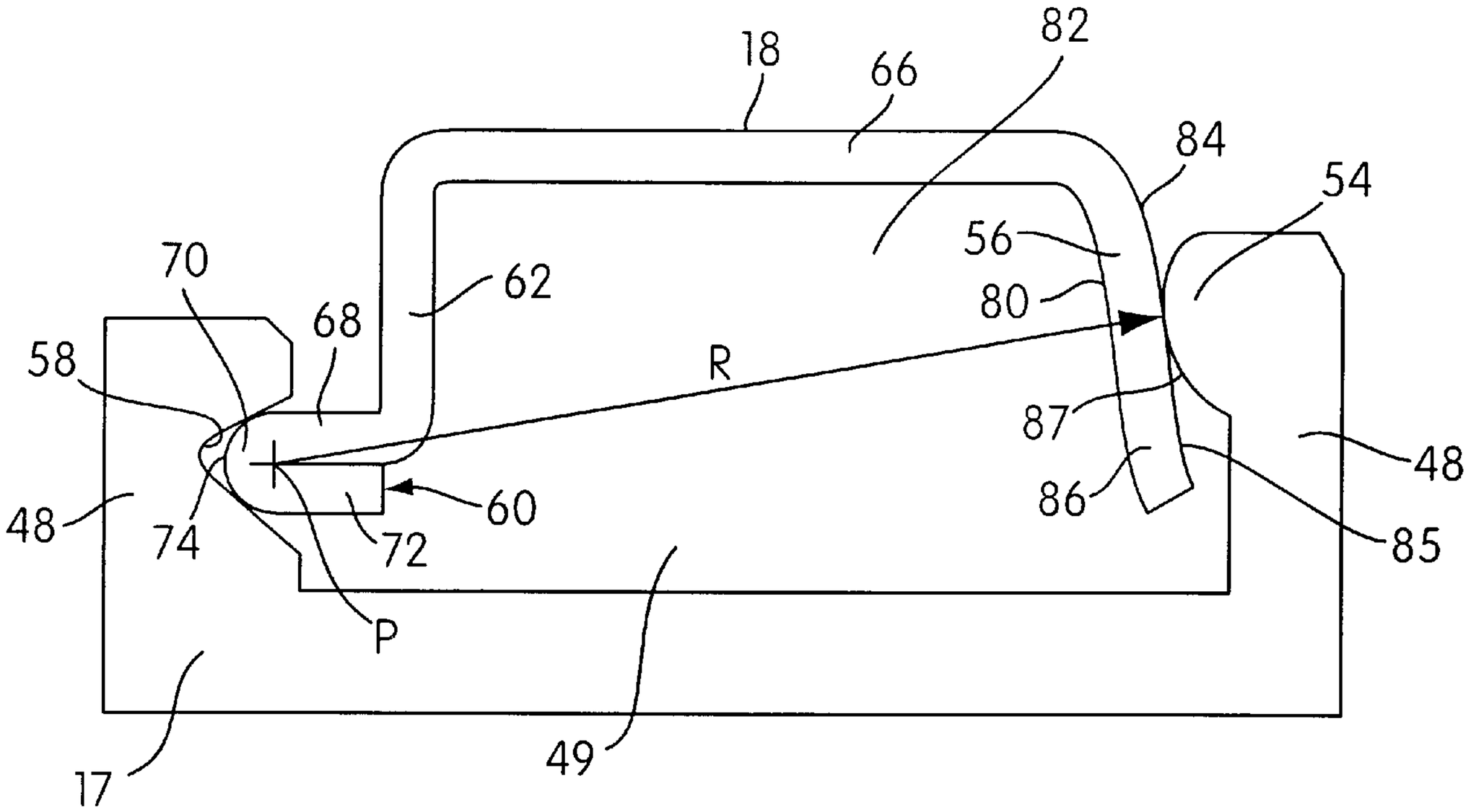

FIG. 5

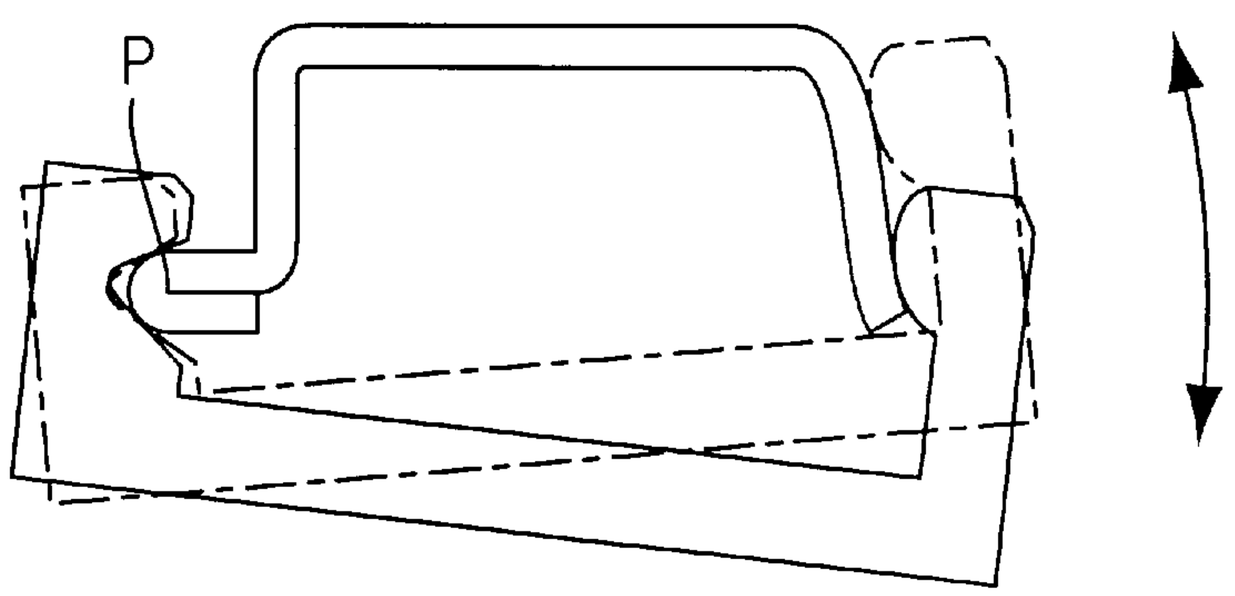

FIG. 6

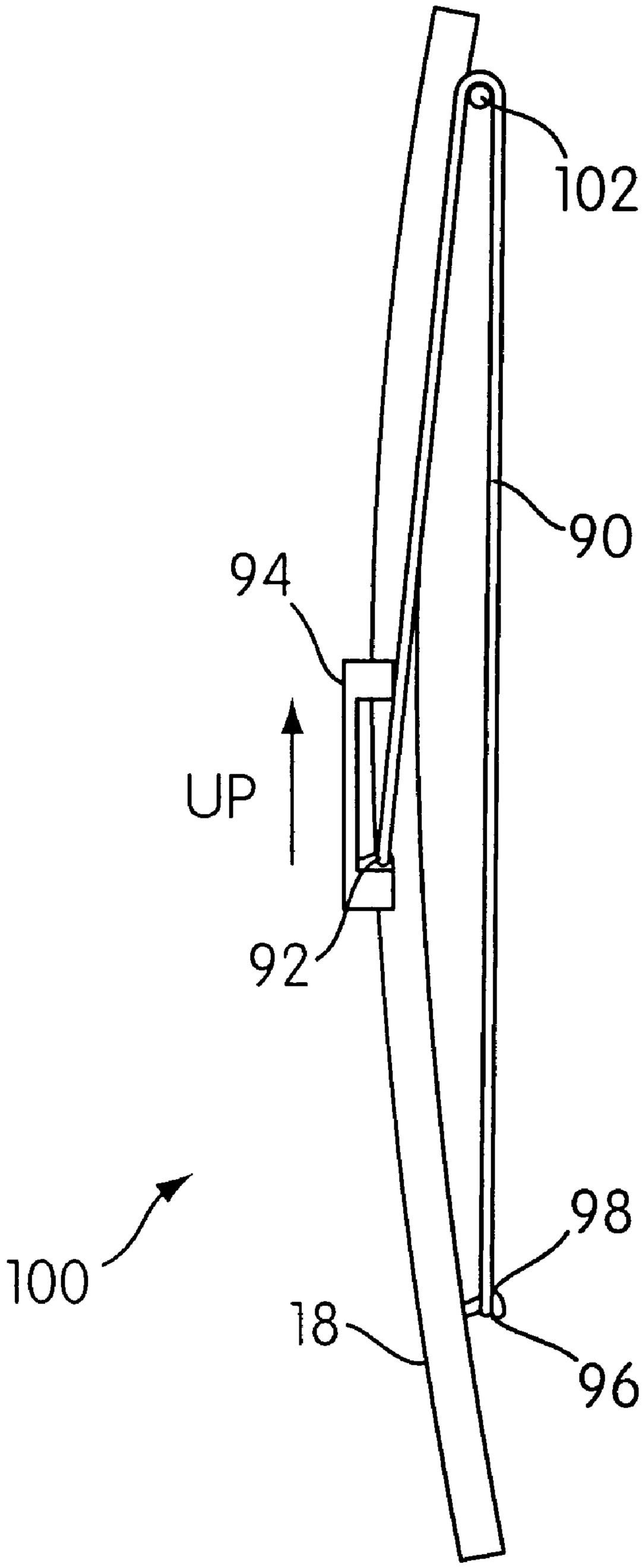

FIG. 7

WINDOW REGULATOR MECHANISM

This application claims benefit of Provisional application 60/045,698, filed May 6, 1999.

BACKGROUND OF THE INVENTION

The present invention relates to window regulator mechanisms. More particularly the present invention relates to a window regulator mechanism which reduces or eliminate vibrations which occur when a motor vehicle door is forcibly closed.

Conventional window regulator mechanisms comprise a slider member slidably mounted on a guide rail member and a lifter plate engaged with the window panel and attached to the slider member. An actuating mechanism in the form of an electric motor or a crank handle retracts one of a pair of wires attached to the slider member so as to slidably move the slider member along the guide rail member and raise or lower the window panel with respect to the vehicle door. Oftentimes, during assembly or over an extended period of usage, these components may become misaligned within the vehicle door. As a result, it is desirable to provide some free play between the guide rail member and the slider member in order to compensate for such misalignments and any other irregularities which may otherwise occur. Typically, conventional window regulator mechanisms permit rotational free play and free play in both the inboard/outboard and the fore/aft directions of the vehicle.

One problem associated with providing such free play in the conventional manner occurs when the vehicle door is forcibly shut or slammed. When the vehicle door is forcibly shut, the free play permitted between the guide rail member and the slider body results in vibrations and vibratory noise which lasts for a short period of time thereafter. One way to reduce these vibrations is to pinch the guide rail and slider member close together and eliminate the free play. This, however, does not allow for any misalignment or irregularities of the mechanism components and also increases the amount of operating effort required to raise and lower the window panel.

Thus, it is an object of the present invention to provide a window regulator mechanism which utilizes a limited amount of free play in order to correct any misalignments between the components thereof while at the same time eliminating or minimizing the vibrations which occurs as a result of movement of the slider member and guide rail member after the vehicle door has been forcibly closed.

The present invention is a window regulator mechanism for vertically moving a window panel mounted within a motor vehicle door. The mechanism comprises an elongated guide rail member mounted within the vehicle door and extending longitudinally in a vertical direction. The guide rail member has a base portion with a pair of side flange portions extending longitudinally along opposing sides thereof to define a guide rail channel therebetween. A first of the pair of side flange portions has a nose portion extending laterally outwardly therefrom. A second of the pair of side flange portions has a laterally outwardly facing convex exterior surface.

A window moving structure engages the window panel. The window moving structure has a base member and a pair of side leg portions extending from opposing sides thereof to define a window moving structure channel therebetween. One of the side leg portions has a nose-receiving groove formed in an inwardly facing surface thereof. The window moving structure is slidably mounted on the guide rail

member to allow the window panel to be moved vertically with respect to the vehicle door.

A manually operable actuating mechanism is constructed and arranged to slidably move the window moving structure vertically along the guide rail member so that the window panel is moved vertically with respect to the vehicle door in response to manual operation. The nose portion of the guide rail member is received within the nose-receiving groove of the window moving structure and the convex exterior surface of the guide rail member is slidably engaged with an inwardly facing surface of another of the side leg portions of the window moving structure opposite the nose-receiving groove such that (1) relative pivotal movement between the guide rail member and the window moving structure about a fixed pivot axis extending longitudinally through the nose portion is permitted and (2) relative movement between the guide rail member and the window moving structure in a radial direction with respect to the fixed pivot axis is substantially restricted to thereby reduce vibrations which occur as a result of forcibly moving the vehicle door into closing engagement with a motor vehicle body.

Another aspect of the present invention is a window regulator mechanism for vertically moving a window panel mounted within a motor vehicle door. The mechanism comprises an elongated guide rail member mounted within the vehicle door and extending longitudinally in a vertical direction. The guide rail member has a base portion with a pair of side flange portions extending longitudinally along opposing sides thereof to define a guide rail channel therebetween.

A window moving structure engages the window panel. The window moving structure has a base member and a pair of side leg portions extending from opposing sides thereof to define a window moving structure channel therebetween. The window moving structure is slidably mounted on the guide rail member to allow the window panel to be moved vertically with respect to the vehicle door. A manually operable actuating mechanism is constructed and arranged to slidably move the window moving structure vertically along the guide rail member so that the window panel is moved vertically with respect to the vehicle door in response to manual operation. The guide rail member is slidably mounted on the window moving structure such that (1) relative pivotal movement between the guide rail member and the window moving structure about a fixed pivot axis extending longitudinally through the guide rail member is permitted and (2) relative movement between the guide rail member and the window moving structure in a radial direction with respect to the fixed pivot axis is substantially restricted to thereby reduce vibrations which occur as a result of forcibly moving the vehicle door into closing engagement with a motor vehicle body.

A further object of the present invention is to provide an assembly for guidably mounting a motor vehicle window panel for vertical movement. The assembly basically comprises the elongated guide rail member and window moving structure as discussed above.

Other objects, features and characteristics of the present invention, as well as the method of operation and function of the related elements of the structure, and the combination of the parts and economics of manufacture, will become more apparent upon consideration of the following detailed description and appended claims with reference to the accompanying drawings, all of which form a part of this specification.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a sectional view of a window regulator mechanism embodying the principles of the present invention shown as incorporated in an automotive vehicle door structure;

FIG. **2** is a schematic perspective view of the window regulator mechanism of FIG. **1** in combination with a lift plate slider assembly;

FIG. **3** is a cross-sectional view taken through the line **3—3** in FIG. **2**;

FIG. **4** is a perspective view showing the slider member and a portion of the rail channel in accordance with the principles of the present invention;

FIG. **5** is a cross-sectional view of the slider member and rail channel in accordance with the present invention;

FIG. **6** is a cross-sectional view similar to that of FIG. **5**, but showing the tilting or rotational capabilities of the slider member relative to the guide rail member; and

FIG. **7** is a schematic side plan view showing a motor vehicle window counterbalance assembly with certain components removed in order to more clearly show its construction.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

In FIG. **1**, the window regulator mechanism is shown as incorporated in an automotive vehicle door structure **10** for operating a vertically movable window panel **12**. The door structure comprises an inner panel **14** formed at its lower portion with a terminal flange over which the marginal portion of an outer panel is crimped to provide an integral structure having a space or well between the inner and outer panels. The window well has a slot or access opening through which the window panel **12** is slidably moved into and out of the well by the window regulator mechanism positioned at the inner side of the path of travel of the window panel **12**. The window regulator mechanism includes a lifter plate **16** engaging the lower portion of the window panel **12**. A slider member **17** is secured to the lifter plate **16** and mounted for sliding movement along a longitudinal guide rail member **18** bolted on the inner panel **14**. Together the slider member **17** and the lifter plate **16** constitute a window moving structure. The guide rail member **18** is preferably steel or aluminum and formed by stamping. An actuating mechanism in the form of a drive unit **20** is mounted on the inner panel to aid in unwinding one of two wires **W1** and **W2** and retracting the other wire so as to vertically move the lifter plate **16** and window panel **12**.

Referring to FIG. **2**, the guide rail member **18** has at its lower end a semi-circular guide plate **22** secured thereon for guiding the wire **W1** and at its upper end a guide pulley **24** secured rotatably thereon for guiding the wire **W2**. The vertically spaced-apart guide plate **22** and pulley **24** can be referred to as guiding portions and constitute the limits of movement of the lifter plate **16**. The guide plate **18** also has a guide opening **26** for guiding the wires **W1** and **W2** toward the drive unit **20** which is shown schematically as including drive and driven drums **28** and **30** housed within a casing **32**. The drive drum **28** can be driven in response to manual operation in a conventional fashion by a window crank handle **40** or by an electrically powered motor.

The slider member **17** has a nipple housing member **34** constructed and arranged to fixedly attach wire beads **36** fixed to the wire or cable **W2**. This enables the slider member **17** to be slidably driven along guide rail member **18** upon movement of wires **W1**, **W2**. The wire **W1** extends downward from the nipple housing **34** to the semi-circular guide plate **22** around which it extends upward to the pulley **24** and through guide opening **26** and then through a guide tube to the drive drum **28**. The wire **W2** extends upward from the nipple housing **34** to the guide pulley **24** around which it extends to the guide opening **26** and then through a guide tube to the driven drum **30**. The driven drum **28** rotates in a first or second rotational direction with rotation of the crank handle **40** in a conventional fashion to drive the driven drum **28** and effect movement of the wires **W1**, **W2** through the guide tubes. This in turn causes upwards or downwards vertical movement of the slider member **17** along the guide rail member **18** depending on the direction in which the crank handle **40** is rotated.

Turning now to FIG. **3** there is shown a cross-sectional view of the lifter plate **16**, the slider member **17**, and the steel guide rail member **18** onto which the slider member **17** is slidably mounted.

The lifter plate **16** is secured to the window panel **12** in conventional fashion. The lifter plate **16** has tab members **44** punched through the metal material thereof, which forms openings **45** in the remaining portions of the lifter plate **16**. The tab members **44** are crimped around opposite edges **46** defined by a surface extending between leg portions **48** of the slider member **17** (see FIG. **4**).

The slider member **17** is molded from a plastic material. It is also provided with a plurality (3) of locating projections **50** constructed and arranged to be received to be received in corresponding holes in the lifter plate **16** for proper alignment between the slider member **17** and the lifter plate **16** with the window panel **12** attached thereto.

It can be appreciated that from FIG. **4** that the slider member **17** has a plate-like base portion **52** having a generally quadrilateral configuration. Four leg portions **48** extend generally from the corners of the base portion **52** and define a recess **53** therebetween in which the tab members **44** are received for fixing the lifter plate **16** to the wedge slider body **17**. The leg portions **48** of the slider body **17** located on one side of the base portion **52** are provided with inwardly projecting portions **54** which are particularly constructed and arranged to slidably engage the convex exterior surface **84** of a side flange portion **56** of the guide rail member **18**. The opposite leg portions **48** disposed on an opposite side of the base portion **52** are provided with "V"-shaped grooves **58** defined by a pair of inclined surfaces and which are particularly constructed and arranged to receive a nose portion **60** extending laterally outwardly from the end of a side flange portion **62** opposite the side flange portion **56**. The side leg portions **48** define a window moving structure channel **49** therebetween.

Referring now more particularly to the guide rail member **18**, it can be seen that it includes a longitudinally extending base portion **66**, and that the side flange portions **56** and **62** extend outwardly from opposite transverse ends of the base portion **66** to define a guide rail channel **82** therebetween. The side flange portion **62** initially extends from the base portion **66** in a generally perpendicular relation to the base portion **66**. The nose portion **60** of the side flange portion **62** is a folded over end portion and includes a longitudinal strip of metal **68** extending laterally outwardly away from the guide rail channel **82** formed by the steel guide rail member **18**, a rounded end region **70**, and a longitudinally extending flat portion **72** disposed in overlying relation with respect to the strip **68**. The exterior surface provided by the rounded portion **70** has a generally rounded exterior surface **74** which is received within the "V"-shaped nose-receiving grooves **58** in the side leg portions **48** adjacent thereto. It can be appreciated from FIG. **3** that the "V" shaped groove **58** forms a relatively acute angle, and that the more oblique or rounded exterior surface **74** of the arcuate portion **70** of nose

portion **60** does not engage the vertex of the angled groove **58**. Rather, the rounded surface **74** engages the relatively flat inclined surfaces on opposite sides of the vertex for groove **58**.

The opposite side flange **56** has somewhat of a curved or arcuate convex configuration as it extends outwardly from base portion **66**. In particular, as shown in FIG. **3**, the side flange portion **56** has a generally concave lower interior surface **80** facing the channel **82** defined by the guide rail member **18**, and a generally convex exterior surface **84** which slidably engages the inwardly facing surfaces **87** of the projecting portions **54** of the respective leg portions **48**. As can be appreciated from arrow R in FIG. **5**, the center of curvature of the convex exterior surface **84** originates or coincides with the center of curvature of the nose portion **70** of the opposite folded flange portion **60** as shown. In other words the convex exterior surface **84** is defined by an arc segment of an imaginary circle having a centerpoint coinciding with the pivot axis P extending through the nose longitudinally portion which will be discussed below in further detail.

The end portion **86** of the side flange portion **56** is bent slightly outwardly in an opposite direction from the more proximal portions of the side flange portion **56** in a direction slightly away from the channel **82** to provide a concave exterior surface **85** adjacent the convex exterior surface **84**. As a whole, the side flange portion **56** has a slight "S" shaped configuration as viewed in the position shown in FIG. **3** (inverted "S" in FIGS. **5** and **6**).

The projecting portions **54** of the respective leg portions **48** have an inwardly facing surface **87** which engages the lower convex exterior surface **84** of the side flange **56**. Inwardly facing surface **87** is provided with an arcuate or rounded configuration. The design in accordance with the present invention permits freedom of rotation of the slider member **17** (and the components mounted thereto) about a fixed axis running longitudinally along the guide rail member **18**, generally about a fixed pivot axis P as shown, which is the aforementioned center of curvature of the convex exterior surface **84** of side flange **56** (see FIG. **6**). The slider member **17** pivots about fixed pivot axis P by permitting the exterior curved surface **87** of the projecting portions **54** to move in sliding engagement about the circular path defined by the exterior convex surface **84**. In addition, the "V"-shaped groove **58** permits the curved exterior surface **74** of the folded flange portion **60** to be rotatably received therein and pivot about the pivot axis P.

The concave exterior surface **85** is configured to engage the inwardly facing surfaces **87** of the projecting portions **54** in order to prevent the side leg portion **48** and the side flange portion **56** from moving out of engagement with one another. This function is usually not necessary when the mechanism is installed with the vehicle door, but it is desirable during shipping of the mechanism. Such an arrangement prevents the slider member **17** from becoming separated from the guide rail member **18** and increases assembly efficiency by eliminating the time spent finding and putting together separated components.

It should be appreciated that there is a small interference in the fit between the slider contact surfaces and the guide rail member **18**, thereby providing a chuck-free assembly. The stiffness of the legs **48** which form the "V" shaped grooves are fine-tuned to provide the right amount of resistance to deformation under window tipping forces while at the same time having low friction and wear characteristics. The stiffness can be altered by changing the sizes, the material, or by use of stiffening members.

In an alternate embodiment, the slider member **17** can be molded together with the lifter plate **16** as an integral window moving structure, incorporating the nipple housing **34** to which the wires **W1** and **W2** attach.

The design in accordance with the present invention permits freedom of rotation of the slider member **17** about the pivot axis P to allow for the spiraling action of the rails which are mounted at an angle to the vertical, as can be achieved in other conventionally provided slider/rail designs. In addition, the inboard/outboard freedom is eliminated by the "V"-shaped groove configuration in conjunction with the curved opposite wall of the guide rail member **18** as can be appreciated from the figures. In other words, the relative movement between the guide rail member **18** and the slider member **17** in a radial direction with respect to the pivot axis is substantially prevented.

The advantages of such a construction are two-fold. First of all, the relative pivoting movement of the slider member **17** with respect to the fixed pivot axis P of the guide rail member **18** allows for limited pivotal free play in order to compensate for any irregularities or misalignments which may occur during the machining of the components, installation of the mechanism, or which simply may develop over a period of usage. Second, the construction limits radial movement of the slider member **17** with respect to the guide rail member **18**. By limiting such radial movement, vibrations and resultant vibratory noises which occur when the vehicle door is forcibly moved into closing engagement with the vehicle body are minimized or eliminated because free play in directions other than the pivoting movement allowed about pivot axis P has been prevented.

In a preferred embodiment, the guide rail member **18** is formed in a roll-forming operation. The guide rail member can initially be formed with a symmetric cross-section, and then formed into the provided shape with curving tools and post-forming operations.

In accordance with the present invention, the slider member leg portions **48** need not be resiliently biased inwardly against the side flange portions **56** or **62** to maintain proper engagement. An interference fit without high frictional forces achieved, with zero clearance between the slide member **17** and the guide rail member **18** so as to prevent free play. At the same time, there is a low degree of friction between the slider member **17** and the guide rail member **18** to permit relatively easy movement of the slider member **17** along the guide rail member **18**. Resiliently biasing the leg portions **48** against the side flange portions **56**, however, is preferred because this allows the slider member **17** to be snap-fit into an intermediate portion of the guide rail member **18** rather than sliding it over an end portion thereof. This allows both ends of the guide rail member **18** to be constructed without regard to whether the slider member **17** will later have to be slid over one of the ends. The use of the term snap-fit encompasses the arrangement wherein the window moving structure is slidably mounted on an intermediate portion of the guide rail member by initially engaging the side leg portions with intermediate portions of the side flange portions so that the side leg portions are urged laterally outwardly until the nose-receiving groove reaches the nose portion and the inwardly facing surface of the another side leg portion opposite the nose-receiving groove reaches the convex exterior surface. The side leg portions resiliently move inwardly into engagement with the nose portion and the convex exterior surface to thereby realize a snap-fit engagement.

It should be appreciated that the counterbalance assembly of the present invention can be used for both conventional cable/drum and arm/sector regulators.

The window counter balance assembly of the present invention employs an elastic strap member that is intended to replace conventional steel counter balance springs. The construction of the present invention is less expensive and offers greater flexibility for operation with variations in window design in comparison with the conventional construction.

A counterbalance assembly for a motor vehicle window is shown generally at **100** in FIG. **7**. The counterbalance assembly **100** can also be seen in FIG. **1**. As shown, the assembly **100** includes an elongated, flexible counterbalancing member in the form of an elastic strap **90** connected at a first end **92** thereof to either one of the lifter plate **16** or slider member **17**. For convenience, the combination of the lifter plate **16** and slider member **17** is referred to as a window moving structure and indicated by a single reference numeral **94**. The opposite second end **98** of the elastic strap **90** is secured or fastened to a hook member **96** located within the motor vehicle door. Preferably, the hook member is rigidly secured to the guide rail member **18** at a lower portion on the inboard side thereof (see FIG. **1**).

An intermediate portion of the elastic strap **90** extends over a guiding portion in the form of a rotatable roller or pulley member **102**. The pulley or roller member **102** is rotatably mounted on a central pin or hub member (not shown) which is rigidly fixed to an upper portion of the guide rail member **18**. The location of the pulley or roller member **102** is disposed above the uppermost position of the window moving structure **94**, thereby allowing portions of the elastic strap **90** to extend downwardly to the fixedly attached ends thereof throughout all movements of the window moving structure **94**.

The elastic strap **90** is tensioned between the hook **96** and the window moving structure **94** to apply a substantially constant upward counterbalancing force to the window moving structure **94** and hence the window panel **12** fixed thereto (not shown in FIG. **7**). When the window moving structure **94** is in its uppermost position, the strap is in its initial elastically deformed state.

The counterbalancing assembly **100** is used to facilitate opening and closing of the window panel **12**. In particular, the elastic strap **90** resiliently returns to its initial elastically deformed state and applies an upward counterbalancing force to the window moving structure **12** as it moves from its lowermost to its uppermost position in order counterbalance the downwardly directed forces applied by gravity acting on the relatively heavy window glass **12** and facilitate upward movement of the window panel **12** towards its closed or raised position. In addition, the elastic strap **90** elastically deforms beyond its initial elastically deformed state and applies a certain degree of resistance in the form of the upwardly directed counterbalancing force against the downwardly directed force of gravity as the window moving structure moves from its uppermost to its lowermost position in order to provide a controlled downward movement of the speed of window panel **12**.

The utilization of such a counterbalancing force is particularly useful in window regulators which are actuated by use of a manually engaged crank handle **40**. The counterbalancing force assists the manual application of torque to the crank handle **40** in a window raising rotational direction which effects upward movement of the window **12** towards the closed position. It also helps control the downward speed of the window panel **12** and maintains a smooth manual application of torque movement for the user as he rotates the crank handle **40** in a window lowering rotational direction to lower the window. Preferably, the amount of torque applied to crank handle **40** needed for raising and lowering the window will be approximately the same.

The elastic strap **90** resists aging for a time suitable to provide a useful product life span. The elastic strap **90** should also exhibit high extension capabilities, high fatigue resistance, and should also resist the effects of grease and salt as much as possible. In addition, the elastic strap **90** also remains flexible at low temperatures.

The strap **90** can be manufactured using any conventional resilient elastomeric material. Neoprene is one preferred material, although this material has limited flexibility at low temperatures. Neoprene is a preferred material at temperatures above −45° C. Mypalon, Nitril (Buna-N), and EPDM are also preferred materials.

In the preferred embodiment, the strap **90** is made from EPDM and has a uniform cross-section throughout most of its length. A loop is provided at each end **98** and **92** thereof for connection with the hook **96** and window moving structure **94**, respectively. The preferred cross sectional configuration is somewhat of an oval configuration, approximately 10 mm by about 3 mm. The preferred length of the EPDM strap in its undeformed state (not installed) is about 300 mm. This length of strap can be installed successfully in most vehicles. The length of the 300 mm EPDM strap when the window moving structure **94** is in its uppermost position and the strap **90** is in its initial elastically deformed state is typically about 450 mm and it exhibits an upwardly directed counterbalancing force on the window moving structure **94** of about 6–12N. The preferred length of the EPDM strap when the window moving structure **94** is in its lowermost position is typically about 950 mm and it applies an upwardly directed counterbalancing force on the window moving structure of about 35–40N.

It should be appreciated that the applied forces can easily and finely tuned by changing materials and dimensions of the strap **90**. It is also desirable that the force exerted by the strap **90** on the lifter plate **16** in the uppermost position of the window moving structure **94** should be as close as possible to the force exerted at its lowermost position. This can be achieved by using an elastomeric material which has a fairly low stiffness and by making the minimum installed strap into the full up position.

The preferred embodiment of the strap is uncoated but it is within the scope of this invention to coat the strap if conditions warrant to reduce friction with the pulley **102**. In fact, the present invention contemplates that a coated strap need not be used in conjunction with a rotatable guide pulley, but can be used in conjunction with a non-rotatable pin. The non-rotatable pin itself can be coated with a friction reducing material, such as plastic. However, if the frictional force between the strap and pin is too high, the rotatable guide pulley **102** should be used. In fact the rotatable guide pulley **102** can be made from a low friction plastic or coated therewith.

The above-described construction of the counterbalancing assembly **100** is also disclosed in a co-pending nonprovisional application entitled "Window Regulator Mechanism Having an Elastomeric Counterbalancing Member" invented by Peter J. Smith, also the inventor of the present application, being filed even date herewith (attorney DKT No. 292 REG 2) and being incorporated into the present application by reference thereto. Both the present application and the above-mentioned application of Smith claim priority from a common U.S. Provisional application Ser. No. 60/045,698, the entirety of which is incorporated herein by reference.

The guide rail member **18** and slider member **17** construction of the present invention can be utilized with or without a counterbalancing assembly. Also, it may be used with conventional counterbalancing assemblies which utilize metallic springs or other counterbalancing mechanisms. The counterbalancing assembly **100** described herein is simply a preferred embodiment and it is not intended to limit the scope of the present invention.

While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is understood that the invention is not limited to the disclosed embodiments but, on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

What is claimed is:

1. A window regulator mechanism adapted for vertically moving a window panel mounted within a motor vehicle door, said mechanism comprising:

an elongated guide rail member adapted to be mounted within the vehicle door and extending longitudinally in a generally vertical direction, said guide rail member having a base portion and a pair of side flange portions extending longitudinally along opposing sides of said base portion to define a guide rail channel therebetween, a first of said pair of side flange portions having a nose portion extending laterally outwardly therefrom, a second of said pair of side flange portions having a laterally outwardly facing convex exterior surface;

a window moving structure adapted to engage the window panel, said window moving structure having a base member and a pair of side leg portions extending from opposing sides of said base member to define a window moving structure channel therebetween, one of said side leg portions having a nose-receiving groove formed in an inwardly facing surface thereof, another of said side leg portions having an inwardly facing surface opposite said nose-receiving groove, said window moving structure being slidably mounted on said guide rail member to allow the window panel to be moved vertically with respect to the vehicle door; and

a manually operable actuating mechanism constructed and arranged to slidably move said window moving structure generally vertically along said guide rail member so that said window panel is moved generally vertically with respect to the vehicle door in response to manual operation,

said nose portion of said guide rail member being received within said nose-receiving groove of said window moving structure and said convex exterior surface of said guide rail member being slidably engaged with said inwardly facing surface of said window moving structure such that (1) relative pivotal movement between said guide rail member and said window moving structure about a fixed pivot axis extending longitudinally through said nose portion is permitted during general vertical movement of said window panel and (2) relative movement between said guide rail member and said window moving structure in a radial direction with respect to said fixed pivot axis is substantially restricted to thereby reduce vibrations which occur as a result of forcibly moving the vehicle door into closing engagement with a motor vehicle body.

2. A window regulator mechanism according to claim **1**, wherein said convex exterior surface is defined by an arc segment of an imaginary circle having a centerpoint coinciding with said fixed pivot axis.

3. A window regulator mechanism according to claim **2**, wherein an end portion of said second of said pair of side flange portions has a concave exterior surface adjacent said convex exterior surface and is configured to prevent said inwardly facing surface of said another leg portion and said second of said pair of side flanges from moving out of engagement with one another during relative pivotal movement between said guide rail member and said window moving structure while shipping said window regulating mechanism to thereby prevent said guide rail member and said window moving structure from becoming separated from one another before installation into the vehicle door.

4. A window regulator mechanism according to claim **2**, wherein a laterally outermost portion of said nose portion is rounded,

said nose-receiving channel being a V-shaped nose-receiving groove defined by a pair of inclined surfaces intersecting with one another,

said nose portion being received within said V-shaped nose-receiving groove such that said rounded, laterally outermost portion of said nose portion engages said inclined surfaces of said V-shaped nose-receiving groove.

5. A window regulator mechanism according to claim **1**, wherein said nose portion is a folded end portion of said first of said pair of side flange portions.

6. A window regulator mechanism according to claim **1**, wherein said nose-receiving groove is a V-shaped nose-receiving groove defined by a pair of inclined surfaces intersecting with one another.

7. A window regulator mechanism according to claim **1**, wherein said side leg portions of said window moving structure are biased inwardly against said pair of side flange portions of said guide rail member.

8. A window regulator mechanism according to claim **1**, wherein said window moving structure is slidably mounted on said guide rail member by virtue of an interference fit.

9. A window regulator mechanism according to claim **1**, wherein said window moving structure comprises:

a slider member slidably mounted on said guide rail member, said base member and said leg portions of said window moving structure comprising said slider member; and

a lifter plate engaged with the window panel and fixedly attached to said slider body to thereby allow the window panel to be moved vertically with respect to the vehicle door as said slider member slides vertically along said guide rail member.

10. A window regulator mechanism according to claim **9**, wherein said leg portions of said window moving structure comprise a pair of leg portions extending from each side of said slider member.

11. A window regulator mechanism according to claim **1**, wherein said actuating mechanism comprises:

a first wire attached to said window moving structure and extending upwardly therefrom;

a second wire attached to said window moving structure and extending downwardly therefrom,

said first and second wires being engaged with guiding portions disposed in spaced vertical relation to one another on said guide rail member,

said first and second wires being wound over a driven drum so that rotation of said driven drum in a first rotational direction retracts said first wire and moves

the window panel vertically upward with respect to said vehicle door and rotation of said driven drum in a second rotational direction retracts said second wire and moves the window panel vertically downward with respect to the vehicle door.

12. A window regulator mechanism according to claim **11**, wherein said driven drum is rotated in response to manual movement of a crank handle.

13. A window regulator mechanism according to claim **1**, wherein said inwardly facing surface of said another of said side leg portions of said window moving structure has a rounded configuration.

14. A window regulator mechanism according to claim **1**, wherein said window moving structure is slidably mounted on an intermediate portion of said guide rail member by initially engaging said side leg portions with intermediate portions of said side flange portions so that said side leg portions are urged laterally outwardly until said nose-receiving groove reaches said nose portion and said inwardly facing surface of said another side leg portion opposite said nose-receiving groove reaches said convex exterior surface, said side leg portions resiliently moving inwardly into engagement with said nose portion and said convex exterior surface to thereby realize a snap-fit engagement.

15. A window regulator mechanism adapted for vertically moving a window panel mounted within a motor vehicle door, said mechanism comprising:

an elongated guide rail member adapted to be mounted within the vehicle door and extending longitudinally in a vertical direction, said guide rail member having a base portion with a pair of side flange portions extending longitudinally along opposing sides thereof to define a guide rail channel therebetween;

a window moving structure adapted to engage the window panel, said window moving structure having a base member and a pair of side leg portions extending from opposing sides thereof to define a window moving structure channel therebetween, said window moving structure being slidably mounted on said guide rail member to allow the window panel to be moved vertically with respect to the vehicle door; and

a manually operable actuating mechanism constructed and arranged to slidably move said window moving structure vertically along said guide rail member so that said window panel is moved vertically with respect to the vehicle door in response to manual operation,

said window moving structure being slidably mounted on said guide rail member such that (1) relative pivotal movement between said guide rail member and said window moving structure about a fixed pivot axis extending longitudinally through said guide rail member is permitted during general vertical movement of said window panel and (2) relative movement between said guide rail member and said window moving structure in a radial direction with respect to said fixed pivot axis is substantially restricted to thereby reduce vibrations which occur as a result of forcibly moving the vehicle door into closing engagement with a motor vehicle body.

16. A window regulator mechanism according to claim **15**, wherein a first of said pair of side flange portions has a nose portion extending laterally outwardly therefrom and a second of said pair of side flange portions has a laterally outwardly facing convex exterior surface;

one of said side leg portions having a nose-receiving groove formed in an inwardly facing surface thereof,

said nose portion of said guide rail member being received within said nose-receiving groove of said window moving structure and said convex exterior surface of said guide rail member being slidably engaged with an inwardly facing surface of another of said side leg portions of said window moving structure opposite said nose-receiving groove such that (1) relative pivotal movement between said guide rail member and said window moving structure about a fixed pivot axis extending longitudinally through said nose portion is permitted and (2) relative movement between said guide rail member and said window moving structure in a radial direction with respect to said fixed pivot axis is substantially restricted to thereby reduce vibrations which occur as a result of forcibly moving the vehicle door into closing engagement with a motor vehicle body.

17. A window regulator mechanism according to claim **16**, wherein said convex exterior surface is defined by an arc segment of an imaginary circle having a centerpoint coinciding with said fixed pivot axis.

18. A window regulator mechanism according to claim **17**, wherein an end portion of said second of said pair of side flange portions has a concave exterior surface adjacent said convex exterior surface and configured to prevent said inwardly facing surface of said another leg portion and said second of said pair of side flanges from moving out of engagement with one another during relative pivotal movement between said guide rail member and said window moving structure which can occur during shipping of said window regulating mechanism.

19. An assembly adapted for guidably mounting a motor vehicle window panel for vertical movement with respect to a motor vehicle door comprising:

an elongated guide rail member having a base portion and a pair of side flange portions extending longitudinally along opposing sides of the base portion to define a guide rail channel therebetween, a first of said pair of side flange portions having a nose portion extending laterally outwardly therefrom, a second of said pair of side flange portions having a laterally outwardly facing convex exterior surface;

a window moving structure adapted to engage the window panel, said window moving structure having a base member and a pair of side leg portions extending from opposing sides of the base member to define a window moving structure channel therebetween, one of said side leg portions having a nose-receiving groove formed in an inwardly facing surface thereof, another of said side leg portions having an inwardly facing surface opposite said nose-receiving groove, said window moving structure being slidably mounted on said guide rail member to allow the window panel to be moved vertically with respect to the vehicle door;

said nose portion of said guide rail member being received within said nose-receiving groove of said window moving structure and said convex exterior surface of said guide rail member being slidably engaged with said inwardly facing surface of said window moving structure such that (1) relative pivotal movement between said guide rail member and said window moving structure about an axis extending longitudinally through said nose portion is permitted during general vertical movement of said window panel, said convex exterior surface of said guide rail member slidably engaging said inwardly facing surface of said window moving structure during said pivotal movement, and (2) relative movement between said guide rail member and said window moving structure in a radial direction with respect to said axis is substantially prevented.

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